Piezoelectric Technology : Research and Applications

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New piezoelectric materials that exhibit high strain and long fatigue life are under development at the Rockwell Science Center for a variety of DoD, NASA and commercial applications. These piezo-materials include ceramics (PZT and PLZT) and single crystals (PMNT and PZNT), and the products fabricated from these materials include bimorphs, moonies, stack actuators, sensors and transducers. At present, we are fabricating PZT and PLZT ceramics with high strain levels in the range of 0.17 to 0.22%, and under static load these strains increased by 35%. In single crystals (PMNT and PZNT), we recently demonstrated a strain in the range of 0.3 to 0.6% below 20 kV/cm which should rise to 0.8 to 0.9% under higher fields.

Using these high strain materials, we have fabricated different types of actuators such as bimorphs, moonies, and stacks that are demonstrating significantly better performance than commercially available piezo-products, which typically only exhibit strain levels in the range of 0.1 to 0.13%. Stack actuators consisting of 60-80 layers have been successfully implemented in piezo-motors and valves, where both high force and high stroke are required. For applications where high displacement is required, we have fabricated bimorphs and moonies with much higher displacement.

For our NASA application, we are fabricating bimorphs from our high strain PLZT ceramics to achieve sufficient displacement for shape control. Bimorphs are devices consisting of two active layers of a piezoelectric ceramic bonded together. When actuated, the two layers work in conjunction to create a large displacement at the end of device. These bimorphs were fabricated using either conductive or non conductive epoxies in order to compare their performance. Individual layer thicknesses in these devices varied from 0.025 to 0.035 cm. These devices were examined using a cantilever beam arrangement under both electric and photoelectric excitation.

Both approaches were successful in producing sufficient displacement. In this presentation, we will discuss these results as well as the development of high strain piezo-materials.